

# Health effects of PM

## Particles less than 2.5 micrometers

- Acute asthma studies
- Cardiovascular effects
- Diesel effects on immune system
- Diesel particles and allergy
- Lung cancer

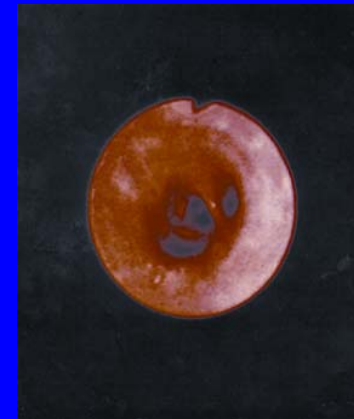
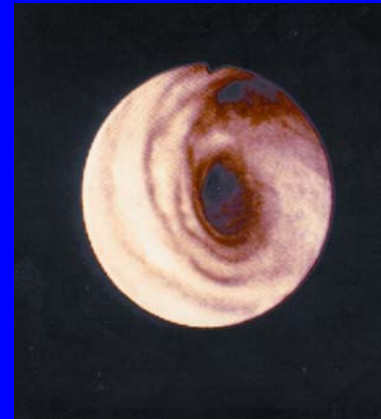
# Who is Affected?

People are affected

- Because of **who they are:**  
age, state of health, genetic predisposition
- Because of the **level of exposure**  
higher level of exposure: greater effect  
(proximity to source may determine level)

# Observations of chronic particle health effects

- **aggravation of asthma**
- inflammation of respiratory membranes
- **bronchoconstriction**
- impaired respiratory defense
- **decreased heart rate variability**
- accumulation of particles in lungs



# Asthma aggravation and PM2.5

- Emergency departments visits in Seattle
  - Increased risk of visit = 1.12 (1.04-1.2) assoc with increased of 30 ug/m<sup>3</sup> PM10--all ages
  - Increased risk of visit = 1.15 in children , 18
- Hospital admissions in Seattle
  - An estimated 5% increase in hospitalization with increases in either PM2.5 or PM10 per IQR of 11.8 ug/m<sup>3</sup>

Yu O, Sheppard L, Lumley T, et al. Effects of ambient air pollution on symptoms of asthma in Seattle-area children enrolled in the CAMP study.

Environ Health Perspect 2000; 108: 1209-1214.

- 133 children with asthma
- Average 58 days of data/child
- Daily symptoms (cough, wheeze, sob)
- Daily PM<sub>2.5</sub>
- 18% (5-33%) increased risk of a symptom/10  $\mu\text{g}/\text{m}^3$  increased in PM<sub>2.5</sub>

# PM and airway inflammation

- Children with asthma in a panel study in Seattle
- Exposure monitoring and health effects outcomes for 10 consecutive days throughout the winter heating season and following spring

# Background

- Exhaled nitric oxide (eNO) is a ubiquitous molecule in the body and is a non-invasive marker of airway inflammation
- eNO is known to be elevated in individuals with asthma, is increased when a subject is having an asthma attack, and is decreased in those individuals using corticosteroid medication
- eNO has been compared with other techniques for measuring inflammation (ex. breath condensate, induced sputum)

# Subject Characteristics



- 19 subjects: 14 male, 5 female
- Ages 6-13
- Medication use:
  - 10 inhaled corticosteroid (ICS) users
  - 9 ICS nonusers
- FEV1%: 67-100%



# Results ICS nonusers

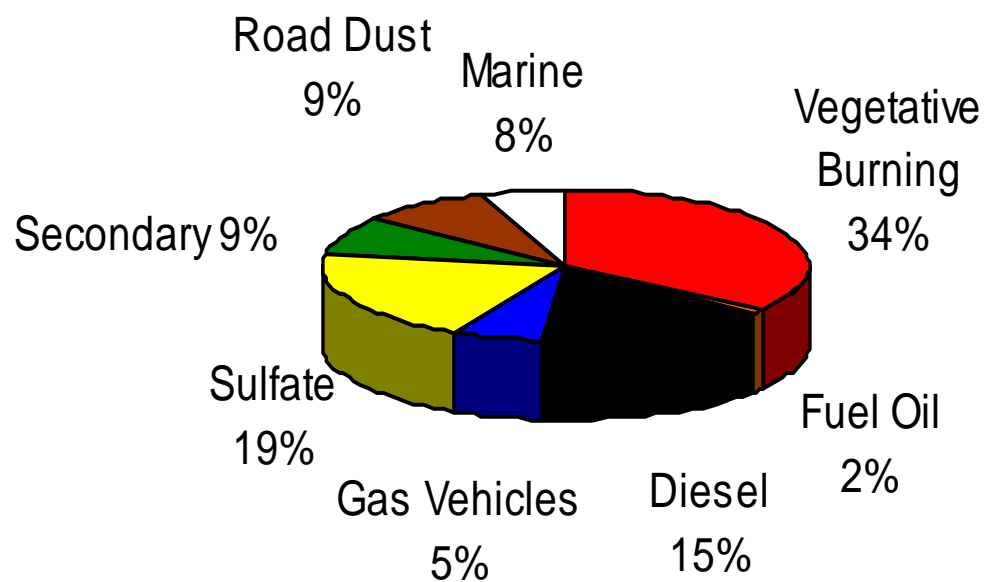
## exhaled NO, ppb (95% CI)

For a  $10 \text{ ug/m}^3$  increase in  $\text{PM}_{2.5}$ , eNO increase

- Personal: 4.5 (1.02, 7.9)
- Indoor: 4.2 (1.02, 7.4)
- Outdoor : 4.3 (1.4, 7.2)
- Central: 4.2 (1.2, 6.4)
- EIG: -3.3 (-1.1, 7.7)
- EAG: 5.0 (0.3, 9.7)

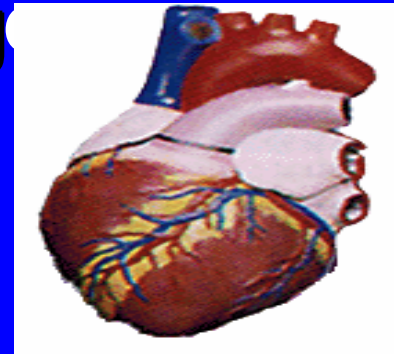
– No effects were seen in ICS users

## PMF SOURCE APPORTIONMENT - SEATTLE BEACON HILL 1996-99 USING CARBON FRACTIONS



## **... and the Heart**

- **Cardiovascular system effects**
  - **Changes in heart rate and heart rate variability**
  - **Blood component changes**
  - **Cardiac arrhythmias**
  - **Heart attacks**

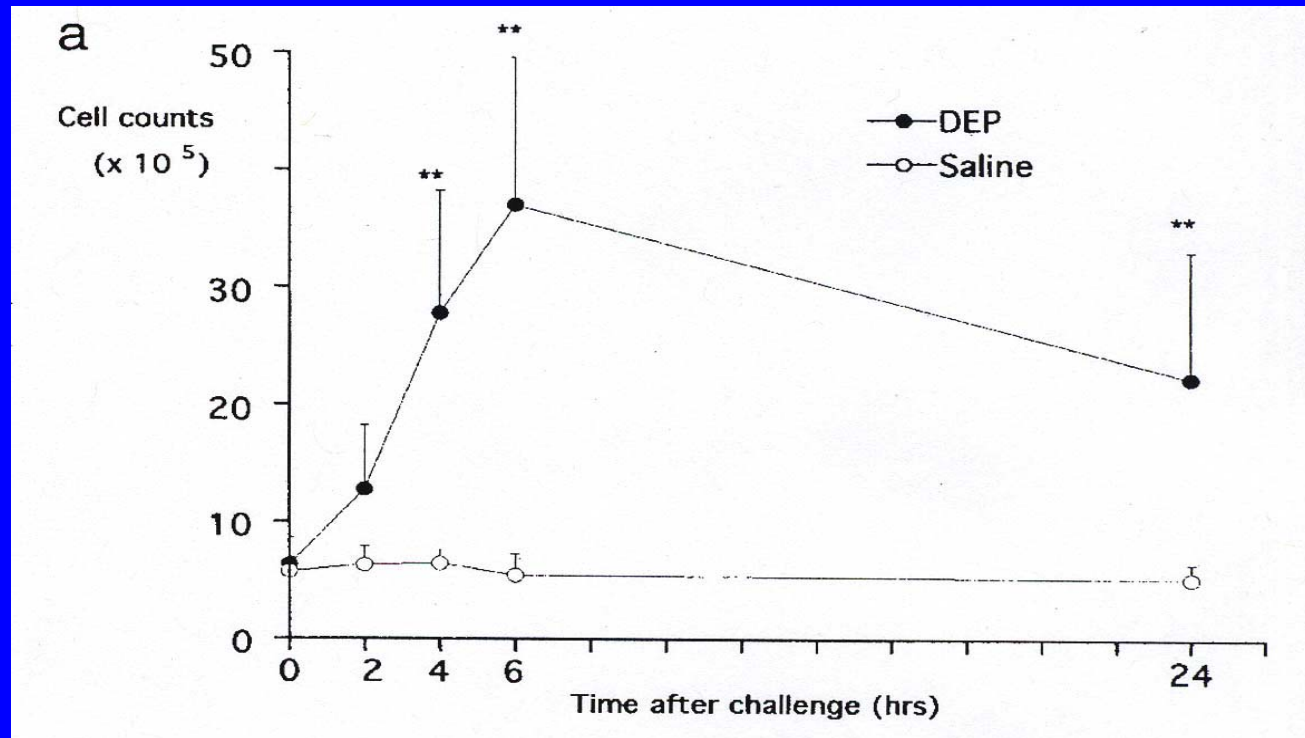


# **Immune Effect of Diesel Particles**

- **Increase in antibody markers for allergy**
- **Localized inflammation**
- **Increase in inflammatory mediators (cause more inflammation)**
- **Increased infiltration of cells characteristic of inflammation into lung, surrounding tissues**

# Immune system and PM

- From Diaz-Sanchez et al. Clin Immunol 97: 140-5, 2000



# Diesel particles and allergy

- Subjects with allergic rhinitis (hay fever)
- Diesel particles or saline instilled into the nose
- Challenged with ragweed allergen
- Diesel + ragweed resulted in increased IgE, a protein known to be active in allergy

# Lung cancer and PM

- American Cancer longitudinal study
- 500,000 volunteers enrolled in 1982
- Deaths linked with annual PM levels in metropolitan areas
- All cause death: 1.06 (1.2-1.10)
- CV death: 1.08 (1.02-1.14)
- Lung Cancer: 1.13 (1.04-1.22)

# **Carcinogenic Effects**

- **Causal for lung cancer (fulfills epidemiological criteria for causality)**
- **3 more lung cancers per 10,000 exposed (California EPA unit risk factor)**
- **Other cancers probable: bladder, liver, blood and lymphatic cancers**



# Health effects from long-term, low level exposures

## Illness

- increase in chronic respiratory illness
- decrease lung function in children  
(predisposes children to Chronic Obstructive Pulmonary Disease as adults)

## Death

- **increases overall death rate** (not just in individuals near death)

# Who dies from short-term exposures to fine particles?

- individuals with chronic pulmonary disease
  - bronchitis, emphysema, asthma
- individuals with cardiovascular disease
- individuals with infections
  - flu, pneumonia
- elderly
- infants

# Good news in California Children's Health Study

- When children leave polluted areas, their lung growth begins to catch up to normal
- Lung function improves
- Fewer symptoms and asthma attacks, although asthma is not cured
- **THEREFORE decrements in lung function, lung growth, and severity of asthma can get better IF AIR POLLUTION IS REDUCED!**

